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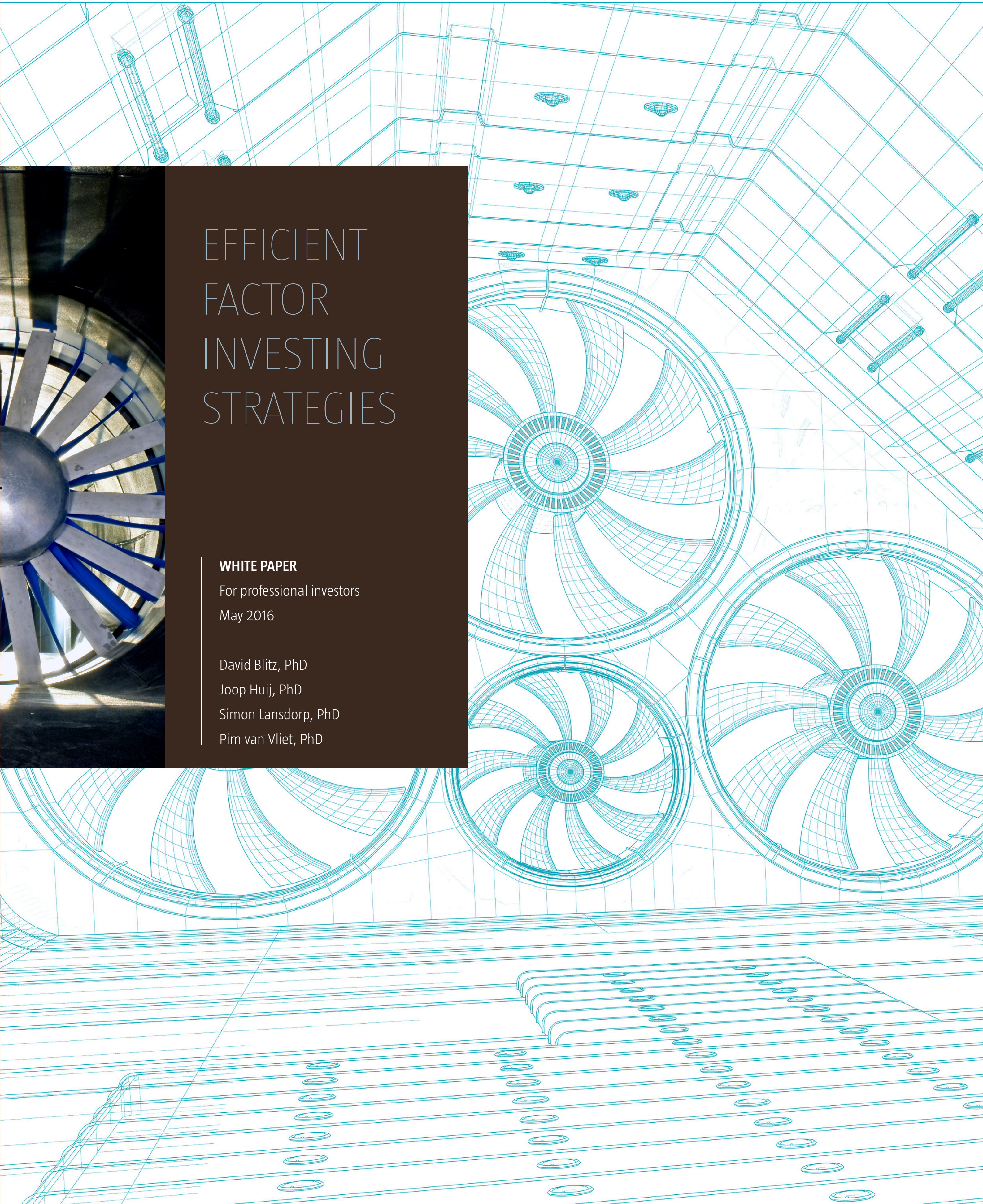
The Investment Engineers



EFFICIENT FACTOR INVESTING STRATEGIES

WHITE PAPER
For professional investors
May 2016

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Contents

Intro

Investors increasingly decide to allocate strategically to factor premiums such as the value, momentum, low-volatility and quality premiums. We argue that generic factor strategies are suboptimal because they involve significant exposures to unrewarded risks, and that more efficient factor investing approaches are able to generate superior risk-adjusted returns. Finally, we discuss how the optimal combination of factors in an institutional portfolio depends on investor preferences.

The rise of factor investing

Is the capitalization-weighted broad market index an efficient portfolio? This is a fundamental question which every investor should think carefully about. If the answer is affirmative, investing is pretty simple. All an investor needs to do in this case is to simply replicate the broad market index, which can be done at minimal costs nowadays. The academic literature, however, indicates that this is probably a suboptimal approach. Numerous studies in the stream of literature on empirical asset pricing have shown that stocks with certain factor characteristics deliver superior risk-adjusted returns. Examples of such factor premiums include the value effect, the momentum effect, the low-volatility effect and the quality effect.

> 'Stocks with certain factor characteristics deliver superior risk-adjusted returns'

However, this does not mean that it is easy to 'beat the market'. In fact, since all investors together comprise the market, it is not surprising that mutual funds on aggregate have been found to underperform the market after fees and expenses. Interestingly, however, the literature on mutual fund performance evaluation also documents that certain groups of funds do succeed in systematically generating superior results. Moreover, there appears to be a close link between these studies and the asset pricing literature, as most of the alpha of winner funds can, in fact, be explained by the same factor premiums which have emerged from the asset pricing literature; see, e.g. Carhart (1997). In other words, the best mutual funds appear to benefit from proven factor premiums.

Practical implications | But what are the practical implications of these findings? The answer was recently provided by three renowned professors: Andrew Ang (Columbia Business School), William Goetzmann (Yale School of Management) and Stephen Schaefer (London Business School). These professors were consulted by Norges Bank Investment Management (NBIM), one of the largest investment managers in the world, responsible for managing EUR 700 billion of Norway's oil wealth, to critically evaluate the added value of its active management. In line with Carhart (1997), they found that approximately 70% of all active returns to NBIM since its inception in 1998 could be explained by exposures to various systematic factors. The analysis also highlighted that these factor exposures were actually a byproduct of bottom-up security selection by the managers hired by NBIM. The authors recommended NBIM to begin using a more top-down, intentional approach to strategic and dynamic factor exposures, and to examine how individual factor premiums could be harvested in the most efficient manner. After this research was made public in 2009, strategic allocation to factor premiums was dubbed by some as 'the Norway model'.

Robeco has contributed to this debate by conducting a study on how investors may apply factor investing to their equity portfolio in practice. We found that the value, momentum low-volatility premiums have been particularly large and robust over time and over different markets. Even using more conservative expected returns for the future, we found that the optimal allocation to these premiums should be sizable. Moreover, the allocation to factor premiums should be diversified (where a simple equal-weighted approach already seems to be quite efficient) and determined strategically (in order to avoid chasing recently winning styles).[1] In a recent study[2] we revisited this recommendation using five years of new data and also incorporating the quality factor. We showed that in 'out-of-sample' data such a factor investing strategy continued to add value. Interestingly, similar factor premiums appear to be present in other asset classes, such as bonds[3], and commodities.[4]

[1] Blitz, "Strategic allocation to premiums in the equity market", *Journal of Index Investing*, 2012

[2] Blitz, "Factor Investing Revisited", *The Journal of Index Investing*, 2015

[3] Houweling and Van Zundert, "Factor Investing in the Credit Market", working paper, 2015

[4] Blitz and De Groot, "Strategicallocation to commodity factor premiums", *Journal of Alternative Investments*, 2014

Pitfalls of factor indices

One way to capture factor premiums in practice is by following an index which is either explicitly or implicitly designed to benefit from factor premiums. Examples are value-weighted indices, equal-weighted indices and risk-weighted indices. Several index providers (such as MSCI and FTSE) provide such alternatively weighted indexes, and passive managers have introduced index funds and exchange-traded funds which follow such indexes. While factor beta or 'smart beta' approaches have proven that they are able to benefit from factor premiums, investors should be aware of their pitfalls.[5] Examples of such pitfalls include uncompensated risks, high turnover, going against other factor premiums and, related, inefficiently combining factors. A more sophisticated approach may therefore offer significantly better performance.

'Investors should be aware of the pitfalls of smart beta'

A more sophisticated approach | For many years, the Robeco Investment Research team has concentrated on analyzing, evaluating, and designing various factor strategies. We found it is of crucial importance to understand the source of a factor premium and then use this information to implement factor strategies efficiently. Key issues with efficient implementation are removing unrewarded risks and limiting unnecessary turnover. Below is a synopsis of what we've discovered about value, momentum, low-volatility, and quality investing over the years.

The value premium | The value effect is the tendency for inexpensive stocks, measured for example by the price-to-book ratio, to have above-market returns. It is well documented in the academic literature, where it has been identified over long time periods and in a variety of regions, including the US, Japan, Europe and emerging markets. One stream of literature proposes that the value premium is a compensation for risk. Professors Eugene Fama and Kenneth French argue that the value premium specifically reflects a reward for relative distress risk, although empirical evidence supporting this assertion has been elusive.

We studied the supposed positive relationship between distress risk and the value effect using a simple premise: if the value premium is a compensation for distress risk, the return from value should rise as bankruptcy risk increases. We tested a number of different measures of distress risk, including accounting models, structural models, credit spreads and credit ratings, and used a conventional implementation of a value strategy, based on price-to-book. While we found that conventional value strategies are typically exposed to distress risk, we found no empirical evidence that distress risk explains the value premium.[6]

We believe our research finding has significant implications for investors in value strategies, as our results show that it is not necessary to take on distress risk in order to profit from the value premium. A more sophisticated value strategy may be designed by explicitly avoiding financially distressed firms.

[5]For a more extensive discussion of the pitfalls of smart beta approaches we refer to: Blitz, "How smart is 'Smart Beta' investing", *Journal of Indexes*, March/April 2013

[6]De Groot and Huij, "Are the Fama-French factors really compensations for distress risk?", SSRN working paper, 2015

The momentum premium | Momentum is the tendency for stocks that have performed well in the recent past to continue to perform well; and for stocks that have performed poorly to continue to perform poorly. The momentum effect was first documented in the early nineties[7], and has been confirmed in numerous subsequent studies. The momentum effect has also been found to be responsible for most of the persistence in actively managed fund performance.

There are two well-documented issues that plague the implementation of a momentum strategy. The first and biggest hurdle to exploiting momentum is the risk associated with momentum investing. Although momentum offers high average returns in the long run, the short-term performance can be very poor, such as in 2009. The second concern with momentum investing is that it involves high turnover and therefore significant trading costs. Our research and experience show that these concerns can be effectively addressed by avoiding unrewarded risks and by not trading too aggressively.

While there is a broad consensus that the momentum effect exists, there is no consensus as to why. Just as with other anomalies in the equity market, risk has been proposed as the source of the momentum premium, although, again, this does not convincingly explain the premium. Other interpretations attribute the momentum factor to mispricing that arises from a gradual diffusion of information in the market. What we found, in contrast to other academic studies, was that although momentum appears to involve little exposure to risk factors in the long run, these exposures can be huge in the short run. A conventional momentum strategy tends to involve large negative or positive betas, depending on recent market returns. This characteristic is beneficial when markets are trending. But when, for example, they suddenly revert, as occurred in 2009 when many stocks that were hit hard by the credit crisis showed a recovery, a simple momentum strategy may exhibit large negative returns.

Our research looked into the risk intrinsic to a momentum strategy.[8] We found that half of the risk does not contribute to the strategy's return. We then developed a proprietary risk management technique to remove these unrewarded risks. The application of this risk management technique for momentum strategies halves the volatility compared with a conventional momentum strategy, while maintaining the strategy's returns, which results in a doubling of the Sharpe ratio.

The low-volatility premium | The low-volatility anomaly was first documented by Robert Haugen and others who tested the capital asset pricing model (CAPM) in the early 1970s. In a long-term study of the US market, Haugen demonstrated that contrary to what is expected by CAPM, low-risk stocks have high risk-adjusted returns.[9] His research, however, was virtually ignored for decades.

'This risk management technique for momentum strategies halves the volatility'

[7]Jegadeesh and Titman. "Returns to buying winners and selling losers: implications for stock market efficiency," *Journal of Finance*, 1993

[8]Blitz, Huij and Martens, "Residual momentum," *Journal of Empirical Finance*, 2011

[9]Haugen and Heins, "On the evidence supporting the existence of risk premiums in the capital market," University of Wisconsin Working Paper, December 1972

We started our work on the subject of low volatility in 2005 and found that the volatility effect is still strongly present in the US market. We also provided strong out-of-sample evidence for the European and Japanese equity markets.[10] Moreover, we found that the anomaly seems to have grown stronger over time, and that it is strongly present among the largest, most liquid stocks in the market.

Generic low-volatility strategies are typically based on a single backward-looking historical risk measure, such as volatility or beta. This construction, however, may expose the strategy to some pitfalls of low-volatility investing, including miscalculated downside risk and underperformance in sharply rising markets. A more sophisticated approach to low-volatility investing can overcome these pitfalls by taking a multi-dimensional view at risk and using a combination of low-risk variables that include both long- and short-term statistical factors.

Our research in optimizing low-volatility strategies also finds that limiting distress risk by augmenting backward-looking risk measures with forward-looking measures helps to better estimate and reduce the expected tail risk of a low-volatility strategy.[11] We believe that a more sophisticated approach to low-volatility investing is necessary, because not all low-volatility stocks are equal and some are destined to perform better than others. This is especially true when low volatility becomes expensive, as is the case in markets now.[12]

The quality premium | The quality effect is the tendency of high-quality stocks to outperform low-quality stocks and the market as a whole. What sets the quality factor apart from the other factors discussed in this note is that 'quality' is less well defined than these other factors. For instance, even though 'value' can be defined using different measures, the consensus is that a stock is considered cheap if the market price is low relative to a fundamental measure; and the low-volatility effect relates to the premium prevalent for low-risk stocks. High-quality companies typically are considered to be highly profitable, have high earnings quality and/or are conservatively managed.[13] Other stock characteristics that are linked to the quality premium are e.g. safety and growth.[14] Hence, quality has a very broad meaning and as a result is much vaguer than the other factor definitions.

A potential issue with this vague factor definition for quality is that the term quality can be misused or even abused. For instance, our research shows that safety, measured by e.g. financial leverage, earnings stability, low credit risk and sometimes even measured using return-based measures like market beta and volatility is actually a very different factor on its own, i.e. the low-volatility (or low-risk) factor. And secondly, we find that other quality definitions have weak or sometimes even non-existent (stand-alone) predictive power for future returns as is the case for growth measures like growth in profitability or earnings growth but also an often used measure like return on equity (ROE).[15] Our concerns with existing generic quality strategies is that these are suboptimal due to the use of poor definitions which

[10]Blitz and Van Vliet, "The volatility effect: lower risk without lower return", *Journal of Portfolio Management*, Fall 2007

[11]Huij, Van Vliet, De Groot and Zhou, "How distress risk can improve low-volatility strategies: lessons learned since 2006", in Low-Volatility Investing, 1st edition, Rotterdam, Robeco collection of articles, 2012

[12]Van Vliet, "Enhancing a low-volatility strategy is particularly helpful when generic low volatility is expensive", Robeco, June 2012. Available at www.robeco.com/lowvolatility

[13]Novy-Marx, "The Other Side of Value: Good Growth and the Gross Profitability Premium" *Journal of Financial Economics*, 2013. Sloan. "Do Stock Prices Reflect Information in Accruals and Cash Flows about Future Earnings?" Accounting Review, 1996. Fama and French, "Profitability, Investment and Average Returns", *Journal of Financial Economics*, 2006

[14]Asness, Frazzini and Pedersen, "Quality minus Junk", Working paper, 2014

[15]Asev, Hanauer, Huij and Lansdorp, "Quality investing – Industry versus academic definitions", Working paper, 2016

are sometimes even mixed with other factors to boost their (back-tested) performance. This approach does not result in achieving efficient exposure to the quality factor to capture the quality premium.

Our research on the quality factor resulted in a multi-dimensional view on quality that incorporates profitability, earnings quality and management policy. Each of these three themes has deeply rooted academic underpinnings and is shown to have a strong stand-alone performance. We believe a sophisticated approach to quality investing will result in a positive and robust return premium.

There has been a vast amount of studies attempting to validate or falsify the existence of the value, momentum and low-volatility premiums For the 'newer' quality factor premium the evidence is strong but it has been put to the test less frequently than the other factors. As such, we are positive on the quality factor but would start with a lower weight to this factor.

Risk of factor premiums going against each other | The examples above illustrate how unrewarded risks that are specific to the value, momentum, and low-risk premiums may be avoided. Another, more general form of unrewarded risk involved with harvesting factor premiums is individual factors having negative exposures to one another. Such a feature is highly undesirable because having negative exposures to factors with positive expected returns lowers the expected return. For example, if a factor index aims to harvest the momentum premium and this index has a negative exposure to the value premium, the expected return on the index is not only a function of the momentum premium, but also of the value premium. And because the expected return of the value premium is positive, the negative exposure of the factor index is expected to hurt its performance. Efficient approaches to obtain factor premium exposure should therefore be designed in such a way that premiums do not go against each other and thereby hurt performance.

'All three index-based strategies deliver a superior risk-adjusted performance'

Enhancing factor strategies

To gauge the economic significance of the insights we discussed in the first part of this note, we performed a series of empirical analyses. First, we analyzed the performance of popular index-based strategies for obtaining value, momentum, low-volatility and quality factor exposure. For the index-based strategies we used the MSCI World Value Weighted index, the MSCI World Momentum index, the MSCI World Minimum Volatility index and the MSCI World Quality index, respectively. For comparison purposes, the performance characteristics of the conventional capitalization-weighted market index are also included.

Intentional and efficient exposure to factor premiums | As table 1 below shows, all four index-based strategies deliver a superior risk-adjusted performance relative to the market, with the return/volatility ratio being in the 0.6-0.8 range, versus 0.5 for the market. For value and momentum this improvement mainly comes from a higher return, while for low-volatility it mainly comes from a lower risk and for quality it comes from both. These results empirically confirm the added value of factor investing.

Table 1. Performance generic factor strategies

	MSCI World	MSCI Value	MSCI Momentum	MSCI Low vol	MSCI Quality
Return	7.3%	8.5%	10.4%	8.6%	11.0%
Volatility	15.0%	15.2%	15.5%	11.3%	13.8%
Return/volatility	0.48	0.56	0.67	0.76	0.80

Source: MSCI. Average returns are calculated geometrically. Sample period: 1988:06-2015:12. Base currency: USD. Largely based on simulations and partly on real-life data.

Next, we computed the same performance metrics incorporating the insights described in the first part of this paper. The results are displayed in table 2 below. Compared with table 1, we observe a significant further improvement in performance, with return/volatility ratios in the 0.8-1 range. This implies that the added value of the Robeco factor solutions is over double that of the index-based solutions. In fact, this still understates the difference in added value, because for the Robeco factor solutions the impact of trading costs is conservatively taken into account, while the index returns conveniently ignore such costs.

Table 2. Performance enhanced factor strategies

	MSCI World	Value+	Momentum+	Low vol+	Quality+
Return	7.3%	13.3%	12.2%	12.3%	12.3%
Volatility	15.0%	15.0%	15.0%	11.8%	13.4%
Return/volatility	0.48	0.88	0.81	1.04	0.92

Source: Robeco, MSCI. Average returns are calculated geometrically. Sample period: 1988:06-2015:12. Base currency: USD. Based on simulations.

Across the board, the improvements in the Sharpe ratios come from both an increase in return and a decrease in risk. The risk reductions are largely due to avoiding unrewarded risks, as described earlier. The risk budget that is released by avoiding the unrewarded risks also enables the efficient approaches to seek higher exposures to the factor premiums (i.e., through higher concentration and active share) resulting in higher returns. For instance, whereas the MSCI Value Weighted index has an active share of only about 25%, the corresponding figure for the Robeco Value strategy is around 90%.

The returns are also higher because of differences in exposures to other factors. For example, the MSCI World Value Weighted and the MSCI World Minimum Volatility indexes both exhibit a negative exposure to the momentum premium, whereas the efficient factor premium strategies are designed to avoid negative exposures to other factor premiums. Based on the above results, we can conclude that the added value of our research insights is sizable.

'Factor investing is beneficial in the long run in all of the cases'

Confirmed by live track-records | Our live track-records confirm the added value of Robeco factor strategies. As table 3 shows, most of our factor funds have not only handsomely outperformed the regular capitalization-weighted index, but also their corresponding factor indices. We note that these results would be even better on a risk-adjusted basis, in particular for our low-volatility (Conservative Equities) strategies, which have lived up to their promise of delivering a much lower volatility than the capitalization-weighted index.

Table 3. Live performance Robeco factor strategies versus MSCI factor indices

Start month	Value all-country Jan 2014	Momentum all-country Sep 2012	Conservative developed Oct 2006	Conservative emerging Mar 2011
Versus regular index				
Robeco	7.7%	14.6%	9.1%	7.5%
MSCI	9.7%	11.9%	5.2%	0.8%
Excess return	-2.0%	2.7%	3.8%	6.8%
Versus factor index				
Robeco	7.7%	14.6%	9.1%	7.5%
MSCI	6.6%	13.1%	7.0%	6.3%
Excess return	1.1%	1.5%	2.1%	1.2%

Source: Robeco, MSCI. Returns are annualized and gross of fees. Base currency: EUR. Data through 31 March 2016. Strategies are: Robeco Quant Value, Robeco Momentum and Robeco Conservative Equities. Indices are MSCI Value-Weighted, MSCI Momentum and MSCI Minimum Volatility (net return). The value of your investments may fluctuate. Results obtained in the past are no guarantee for the future.

Client preferences determine optimal factor combination

Having identified four factors that have proven their long-term performance potential – value, momentum, low-volatility and quality – the next question is which factor(s) an investor should select. Using our Robeco enhanced factor strategies we consider optimal solutions for each client based on their preferences and their current portfolio. Unfortunately, there is little evidence that it is possible to successfully predict which factors are going to do well in the near future and which factors are going to lag. This argues for diversifying across the different factors instead of tactically trying to identify the best one. It also supports our enhanced factor investing approach which limits negative exposure to other proven factors. With these efficient strategies we can construct optimal factor exposures which meet our clients' objectives in a way that is just not possible through an allocation to generic factor indices.

We strongly believe there is no single optimal factor allocation as the optimal factor-investing portfolio depends on investor-specific beliefs and preferences. Given the lack of evidence that one factor dominates the others over the long term and most investors' need for balanced risk exposure, an equally weighted portfolio represents a good starting point for a multi-factor portfolio. However, we would also put more weight to factors for which there is more academic evidence. A recent study by Huij and Van Gelderen[16] shows that it less likely that a factor strategy can be successfully implemented in reality if the empirical evidence on which this knowledge is based is inconclusive. With this knowledge our factor conviction on value, momentum and low-volatility is higher than for quality. The motivation here is that, compared with the other factors, quality is a younger and less widely accepted factor. With this in mind we would suggest a default factor mix consisting of a 30% allocation each to Robeco Value, Momentum and Conservative Equities and a 10% allocation to Robeco Quality. From there, and depending on the preferences and goals of our investors, we can assign more or less weight to certain Robeco factor strategies. We will discuss several other client cases along the main dimensions of risk and return.

First, the low-volatility factor is less attractive for clients who care more about total return than about reducing risk, and for clients who dislike the sensitivity of low-volatility strategies to broad market performance and the significant amount of tracking error involved with that. For those clients we suggest a factor mix consisting of 40% Robeco Value, 40% Robeco Momentum, and 20% Robeco Quality.

Second, if a pension fund's main objective is funding-ratio stability he would probably be best off with an implementation offering downside protection. This could also be a client of which the current portfolio is tilted to high-risk stocks. In these cases it is optimal to allocate to Conservative Equities because of its ability to offer downside protection and improve the Sharpe ratio.

[16]Huij and Van Gelderen, "Academic Knowledge Dissemination in the Mutual Fund Industry: Can Mutual Funds Successfully Adopt Factor Investing Strategies?", *The Journal of Portfolio Management*, 2014

There are also other examples. Some clients allocate to only one or two of the Robeco factor strategies, when the client selects a specific manager for a specific factor. Also other clients have a clear preference for income for which Value and/or Conservative are good solutions as they offer high dividend. Other clients prefer low turnover, for which Momentum is perhaps less well suited and could be excluded from the mix.

In all cases, it is also important to take into account each investor's existing portfolio and factor exposures when building an optimal solution. For instance, an investor who already has a significant value tilt in the core portfolio might want to give less weight to that factor in the factor portfolio.

Final words | Institutional investors are increasingly allocating strategically to factor premiums. We recommend these investors to avoid risks that are not rewarded and that are not necessary for capturing factor premiums. We also recommend avoiding going against other factor premiums. We observe that more and more clients tailor their allocation to factors based on their preferences and current portfolio.

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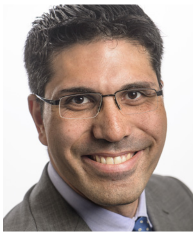
Head Selection Research



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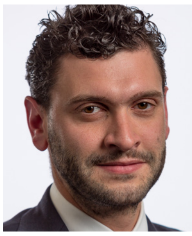

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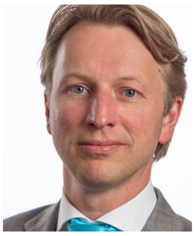

Pim van Vliet, PhD
Portfolio Manager Conservative Equities

Appendix

Robeco's Quantitive Equity product suite | All our Quantitative Equity products are designed to benefit from a number of factor premiums. The key difference between the various Robeco Quantitative Equity capabilities is how they use factor premiums, and with which objective. We distinguish between three key capabilities.

Core Quant | A balanced combination of factors aimed at consistently outperforming a benchmark with controlled tracking error. Our Core Quant strategies use a proprietary, balanced combination of value and momentum factors and a proprietary portfolio construction algorithm, designed to consistently outperform a market benchmark with controlled tracking error. As such, these strategies are designed to maximize the information ratio.

Target clients: clients who allocate to traditional asset classes and look for an asset manager capable of generating consistent alpha, leaving it up to the asset manager to determine the most optimal way to do that.

Conservative Equities | An active low-volatility approach aiming for low risk and high return. Our Conservative Equities strategies use a proprietary stock selection model and portfolio construction algorithm aimed at achieving a lower absolute risk than the market index with similar or higher return, resulting in a high Sharpe ratio. The model is centered around the low-volatility premium, but also uses value and momentum factors to identify the most attractive low-volatility stocks.

Target clients: clients who are interested in capturing the equity premium with less risk and/or clients interested in a high dividend yield.

Factor Investing | Offering clients flexibility to select their preferred combination of factors. Asset owners increasingly decide to allocate strategically to factor premiums next to traditional asset class risk premiums, essentially treating both as equals. These investors wish to select factors and choose factor weights themselves. Robeco has extensive expertise with providing insight into factor exposures of an existing portfolio, and with helping asset owners in setting up their factor investing strategy. In order to service these clients we introduced strategies which specifically aim to harvest the value, momentum, low-volatility and quality premiums. We also offer bespoke factor investing solutions that are designed in close cooperation with the client.

Target clients: clients who consider factor premiums next to traditional asset classes in their strategic asset allocation process and who wish to select factors and choose factor weights themselves.

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